L4: Entry 6 of 6 File: USPT Jun 1, 1993

DOCUMENT-IDENTIFIER: US 5216612 A
TITLE: Intelligent computer integrated maintenance system and method

Brief Summary Text (7):
The art has heretofore suggested adding a maintenance module to a computer integrated manufacturing system in order to integrate maintenance of the production machines into the computer integrated manufacturing system. For example, the Haynes et al. '772 patent noted above discloses a glassware production control system which also provides maintenance information. The Ohno et al. '634 patent noted above also describes a production process control computer which includes a materials and maintenance control subsystem. The materials and maintenance control subsystem controls the timing of parts replacement. The timing of parts replacement is calculated in advance from the cumulative total of the predicted life of consumable parts and operation time and displayed or printed so as to enable order placement for parts. The maintenance system includes a parts list file containing a list of all consumable parts in the system. The parts list file is updated by collecting information on the operation of the machine so that residual service lives of consumable parts may be calculated. When parts replacement is needed, the quantity of parts used for replacement is deducted from the stock volume in the parts inventory file. When the stock volume of parts in the parts inventory file becomes smaller than at the time of parts ordering, an order form slip is printed. In other words, a "point of ordering" system is provided. A running total of elapsed time is computed and compared with the durable life of parts so that the time and date of actual replacement can be calculated and a schedule of maintenance may thereby be derived.

Brief Summary Text (22):
As described above, the intelligent computer integrated maintenance system of the present invention also includes a parts manual management subsystem which controls a parts manual file. The parts manual file contains a complete bill of materials for each production machine. The electronically stored parts manual file does not merely include consumables or maintenance parts. Rather, it includes all parts in the machine in a hierarchial listing, commonly using 5-6 levels of parts, so that a complete subsystem description of the machine is available. Preferably, an electronically stored image of each level is also stored with the listing of parts so that maintenance parts can be identified and repairs are simplified. According to the invention, all parts in the hierarchical listing are categorized as either "consumable", "replaceable", "generic" or "non-stocked". Consumable parts are those for which spare parts planning is based on the number of hours used. For replaceable parts, the mean-time to failure rate versus the actual run time determines the maintenance schedule. For generic parts such as screws, bulk inventory is maintained and a point of ordering system is used. Finally non-stocked parts, which are typically not maintenance parts, are typically not stocked and are not ordered until actually needed.

Brief Summary Text (24):
The spare parts inventory management subsystem of the intelligent computer integrated maintenance system allows ordering of spare parts based on predicted maintenance, rather than on the prescribed inventory levels. Spare parts budgeting is also accommodated. According to the invention, generic parts are ordered using a conventional order point system when the inventory quantities fall below a predetermined order point. For replaceable parts, however, the parts requirements are calculated based on time phased manufacturing requirements and mean-times to failure. The automated parts manual file is used to extend the production plan to parts replacement. A requirement is generated to replace a part in the week that it will exceed its mean-time to failure, and order forms for the parts are generated, or the parts may be ordered electronically.

Detailed Description Text (11):
Parts manual management subsystem 5 is designed to operate with an electronically stored parts manual file 7 which contains a hierarchical listing of all parts in the production machines in the complexes. The parts listing does not merely include maintenance or consumable parts; it includes a complete bill of materials for each production machine. Preferably, accompanying each bill of materials is an image of the associated bill of materials. For a typical machine 5-6 levels of materials are provided with the highest level being the part number for the entire machine, and the lowest level being the lowest replaceable part level for the machine.

Detailed Description Text (30):
Referring to FIG. 3 it will be noted that all parts that comprise a piece of equipment are maintained in the parts manual file, not merely those parts which are consumables or maintenance parts. Accordingly, the parts manual file contains a hierarchical listing of all parts in each machine in the plurality of production complexes. As will be described below, each level of parts in the parts manual file is preferably accompanied by a graphic image illustration of the interrelation of those parts.

Detailed Description Text (31):
All of the parts that comprise a piece of equipment, and which are included in the parts manual file, may be divided into four categories: consumable, replaceable, generic, and non-stocked. Consumable parts are those which are consumed by the production process but not maintained on a list of materials required to produce a product. Some examples include printing dies, tape belts and cutting blades. Because parts of this type must be replaced when they wear out or are used up, they are listed as component items in the parts manual file. According to the invention, spare parts planning for consumable parts is based on future run hours as determined by the maintenance schedule management subsystem 3. For example, tape belts are replaced at the beginning of each production shift. Therefore, each scheduled complex must have a set of tape belts for each production shift scheduled. The total number of tape belts required to support the planned schedule provides the number of belts required each day, week or month.

Detailed Description Text (32):
Replaceable parts are those which have an extended life but are subject to wear or failure. Examples include fans, motors, shafts and drives. These items have a mean-time failure rate which is initially provided by the machine vendor, who is normally the supplier of replacement parts. According to the invention, actual run hours and future run hours for these parts are determined from the master production schedule file and compared to the mean-time failure rate to determine projected parts replacement. When these parts are replaced, the actual run hours are set to zero and the accumulation cycle begins again. The replaceable part information (including for example, complex equipment number, maintenance request number, accumulated hours and other pertinent data) is saved in a parts history file described below. Statistical analysis is applied to review the mean-time failure rate for the part in this complex. If a vendor supplied mean-time failure rate is available, it is reviewed and modified when necessary. When no vendor supplied rate is available, a historical mean-time failure rate will be calculated based on parts history information. The parts manual file also provides information on replacement parts which are still under warranty by the vendor. The vendor's warranty date and/or warranty hours are maintained for the warranty comparison.

Detailed Description Text (37):
It will be understood by those having skill in the art that under certain circumstances it may be necessary to procure replacement parts prior to the modification of the parts manual file. For example, in an efficiency upgrade program, replacement parts may be identified for the improvement before the sequence in which complexes are to be modified has been determined. Another example is when an improvement kit has been obtained but the engineering drawing is not yet available. In both cases "Planning Bills of Material" provide a method of identifying the replacement parts and timing associated with an improvement program. The engineering department can create a planning bill for engineering changes without modifying the parts manual file.

Detailed Description Text (45):
The Spares Inventory Management Subsystem 6 controls the ordering of spare parts. According to the invention, generic items such as nuts, bolts and washers, are reordered using a typical "order point" technique. In other words, when the quantity on hand falls below a predetermined order point, a replacement order is generated for a standard order quantity.

Detailed Description Text (46):
Replaceable parts are managed using time-phased requirement techniques. The planning cycle consists of three steps. First, the time-phase parts requirements are calculated. These requirements come from three sources: parts required to support time-phased maintenance requests, parts defined on planning bills and anticipated parts replacement due to parts exceeding the mean-time failure rate. Anticipated parts replacement takes the current production plan for each complex and extends the plan through the hierarchical description in the automated parts manual. The planned run hours for each week are added to the actual run hours. A requirement is then created to replace the part during the week in which it will exceed the mean-time failure rate and the accumulated run hours are set to zero for that week. This yields the anticipated replacement requirements of all complexes which is summed to derive the total time-phased replacement requirements for the part. The time-phased requirements consumes the on-hand inventory until it is depleted. Spare parts used to support unplanned maintenance are removed from the on-hand inventory when the spare parts are issued. Replacement of these spare parts may cause the system to order them sooner than originally planned.

Detailed Description Text (47):
Finally, a replacement order is created for each week in which requirements exceed the on-hand balance, or safety stock, if one is maintained. The replacement order may be released to the supplier a predetermined number of days prior to when the part is required, based upon the lead-time that the vendor requires to ship the part. All spare parts required to support the maintenance requests, planning bills and replacement parts are combined to determine the total amount to be ordered for each spare part. The system may also generate paper order forms for the parts, or may electronically order the parts.

Detailed Description Text (91):
The operator may then select the next piece of equipment to look at. As shown in FIG. 10A, the packer was selected and display of FIG. 10B is displayed. The packer has eight sections. An image of each is displayed on the left side of the display of FIG. 10B. The upper right corner includes a list of the parts. The lower right corner contains the above described "help", "exit", and "explode bill" option described above. Options also allow detail information (such as company part number, type of part or replacement history) to be displayed, allows return to a higher level in the hierarchy, allows an image to be printed, or a new assembly to be specified.

Detailed Description Text (92):
When the maintenance operator selects option 1 - FRAME SECTION 1" the computer reveals the next level of the machinery shown in FIG. 10C. When the maintenance operator selects option 1-part 0051, the last assembly of this sector appears on the computer along with the parts list (FIG. 10D). This is the lowest level in the hierarchial listing of parts. The maintenance operator may select the parts which are required by placing a `P` beside the parts displayed. The parts will be automatically ordered, assigned an emergency maintenance request number, unless this is a planned modification, and the Parts Manual File will be updated to reflect the replacement parts. The Parts Manual Management Subsystem cooperates with the Spares Inventory Management System, as described below, to review part availability and to automatically issue the requested parts. The Parts Manual Management Subsystem also cooperates with the Maintenance Schedule Management System described above. All planned and unplanned maintenance requests are implemented through the Parts Manual Management Subsystem.

Detailed Description Text (101):
A new part added to the Parts Manual File is classified as "inactive" and will not appear on the Parts Manual File until an engineering change number is assigned. A part to be removed will be flagged as such when the engineering change number is assigned. A replacement part is a two step operation: (1) remove the current part to be replaced; (2) add the replacement part.

Detailed Description Text (103):
FIG. 12 shows two examples of Engineering Change Control (FIG. 11, Block 106) and updating the Parts Manual (FIG. 11, Block 108). The first example in FIG. 12 is for drawing number 0051.01. Engineering Change Number 1010 indicates that this drawing is to be deleted (1010D) and replaced by 0051.01.01 (1010A) on 2/10/XX. Drawing number 0051.01 will be used prior to 2/10/XX. Drawing 0051.01.01 will be used beginning 2/10/XX. The second example in FIG. 12 is for a part replacement. The distributor 4030 will be replaced by 4030.01 on 2/5/XX, controlled by Engineering Change Number 1011. Distributor 4030 is to be used before 2/5/XX (1011D).

Distributor 4030.01 will be used beginning 2/5/XX (1011A). FIG. 13 shows the parts lists in effect on 2/5/XX.- FIG. 14 shows the same parts lists in effect on 2/10/XX. The parts list in FIGS. 12, 13 and 14 represent three different parts lists over a period of time based on the criteria of each engineering change number.

Detailed Description Text (108):
(3) The completion of a maintenance request (Blocks 113 and 117) will close an engineering change number. This can occur when maintenance issues a MR to implement a MIC directive (Block 113) or when emergency maintenance is performed (Block 117). Engineering services will be notified when a part was replaced which was not listed in the Parts Manual File.

Detailed Description Text (125):
Next, referring to FIG. 24, the engineering change control entries are created. ECN 123--Group PM schedule--is date controlled (Block 175) to go into effect on 2/15/xx. ECN 456 is coded as a vendor part replacement to be implemented when Part-F is depleted (Block 173). This requires that Part-F be in the part master file (Block 176) and that the inventory quantity on-hand be greater than 0 (Block 177), plus any reserved stock if desired. ECN 789 is to implement a MIC improvement (Block 172) modification and will be effective when MR123 is completed. ECN 886 is another part use-up (Block 173). This one replaces one XYZ part with another XYZ part. This is the only ECN implemented through the part master.

Detailed Description Text (136):
Referring to FIG. 27, each part issued to a MR (Block 221) is checked to determine if that part is under ECN control (Block 222). The request is suspended (Block 224) and engineering services is notified for corrective action (Block 225) when a part is not under ECN control.

Detailed Description Text (138):
A part issued to a parts list item coded as delete (DEL) (Block 226) is suspended (Block 224) and engineering services is notified for corrective action (Block 225).

Detailed Description Text (141):
The request is suspended (Block 244) and engineering services notified (Block 246) for action when the MR is closed (Block 243) but the ECN is still open (Block 247).

Detailed Description Text (147):
Consumable parts not maintained on the production bill-of-material, such as adhesives, are listed as component items. Dies which print the product logo, inks and cutting blades are further examples of consumable parts not maintained on the production bill-of-materials. These items are replaced when they wear out or are used up. Spare parts for consumables are planned based on future run hours. For example, cutting blades are replaced at the beginning of each production shift. Accordingly, each scheduled complex must have a set of cutting blades for each production shift scheduled. Accumulating the cutting blades required to support the plant schedule yields the amount of cutting blades required each day, week or month.

Detailed Description Text (148):
Replaceable parts, such as fans, motors, shafts and drives, are those spare parts which have an extended life but which can break. These items have a mean-time failure rate which is initially rated by the vendor. The vendor normally supplies these parts. Posting the actual run hours to these parts and accumulating the future run hours provides the ability to compare the run hours to the mean-time failure rate and time-phase projected parts replacement.

Detailed Description Text (149):
In general, Spares Inventory Management Subsystem 8 manages the purchasing of spare parts in the following way: Non-stocked parts are purchased upon request. Generic parts are reordered using typical "Order Point" techniques. In other words, when the quantity on-hand falls below the predetermined order point, a replacement order is placed for a predetermined order quantity. Consumable and replaceable parts are managed using a time-phased requirements technique. This time-phased technique will now be described.

Detailed Description Text (155):
Replacement parts which are still under warranty by the vendor are listed for warranty replacement. The vendor's warranty date and/or warranty hours are maintained for the warranty comparison.

Detailed Description Text (156):
(2) Spare Parts Identified in the Planning Bill: As already described, "Planning Bills" can be set up for regularly scheduled maintenance events such as preventative maintenance, machine configuration changes and consumable parts. This type of planning bill defines each spare part required to perform a maintenance event. This provides greater flexibility to engineering services. A parts list can be maintained for spare parts planning using the planning bill rather than coding the detail in the parts manual file.

Detailed Description Text (169):
(3) Each week that the projected cumulative run hours exceed the mean-time failure rate, a replacement part is required. The projected cumulative run hours is reset by subtracting the mean-time failure rate for the projected cumulative run hours.

Detailed Description Text (189):
Referring again to FIG. 30, at Block 283, the part is checked for ECN use-up control. If the part is to be phased out (replaced) when it is used-up, the remaining requirements for this part must be posted to the substitute part (Block 284). FIG. 34 shows this example. Part 01B16 Part-F is under control of ECN 456--use-up to be replaced by 01B15 Part-E. The first time the projected on-hand goes negative (-3) for this part (Part-F) is week 5 (Block 285). The remaining requirements for week 5 (-3) and all future requirements for this part are posted to the replacement part (01B15 Part-E) at Block 286. The replacement part is at least one planning level lower than the current planning level. This insures that the remaining requirements for this part are included in the requirements for the replacement part. This technique is used for planning purposes only. The ECN will go into effect when the last part is actually issued from spares.

CLAIMS:

13. The computer integrated maintenance system of claim 12 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

34. The computer integrated manufacturing and maintenance system of claim 33 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

55. The computer integrated maintenance method of claim 54 wherein said generating step further comprises the step of generating an electronically stored parts manual including a replacement part number for selected ones of the parts.

76. The computer integrated manufacturing and maintenance method of claim 75 wherein said generating step further comprises the step of electronically stored parts manual which includes a replacement part number for selected ones of the parts.

85. A computer integrated maintenance system for use with a computer integrated manufacturing system, the computer integrated manufacturing system including a computer controller for controlling a plurality of production complexes each of which includes a plurality of production machines, the manufacturing system computer controller including an electronically stored master schedule file having therein a schedule of actual production and planned production for the plurality of complexes, the manufacturing system computer controller controlling the plurality of production machines based upon the planned production in the master schedule file, said computer integrated maintenance system comprising:

an electronically stored parts manual, containing a hierarchical listing of parts in the plurality of production machines in the plurality of production complexes;

maintenance operations computer controlling means, adapted to be communicatively connected to the manufacturing system computer controller, and communicatively connected to the electronically stored parts manual, said maintenance operations computer controlling means comprising:

maintenance schedule management means, for identifying parts in the hierarchical listing to be maintained during a predetermined time period based upon the planned production in the master

schedule file, and for scheduling maintenance activities for the identified parts to reduce disruption of production;

engineering change control management means, for integrating engineering change control activities into the scheduled maintenance activities;

parts manual management means, for updating the hierarchical listing in response to maintenance activities and engineering change control activities; and,

spares inventory management means, for generating requirements to order replacement parts for the identified parts to be available for use in the scheduled maintenance activities.

90. The computer integrated maintenance system of claim 85 wherein said hierarchical listing of parts in said electronically stored parts manual comprises a plurality of parts levels from a lowest level to a highest level, and wherein each part in the lowest level is identified as being one of a consumable part which is consumed by the production process, a replaceable part which has an extended life but is subject to wear or failure, a generic part which is a common part used in large numbers on many of the production machines, and a non-stocked part which does not normally require replacement.

92. The computer integrated maintenance system of claim 91 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

97. The computer integrated maintenance system of claim 85 further comprising:

an electronically stored spares inventory file for identifying generic parts used in said plurality of production machines and replaceable parts used in said plurality of production machines; and

said spares inventory management means further comprising means for generating requirements to order a generic part when an inventory quantity falls below a predetermined quantity and for identifying requirements to order a replacement part to be available for use in the scheduled maintenance activities.

98. A computer integrated manufacturing and maintenance system for controlling manufacturing and maintenance of a plurality of production complexes each of which includes a plurality of production machines, said computer integrated manufacturing and maintenance system comprising:

an electronically stored master schedule file having therein a schedule of actual production and planned production for the plurality of complexes;

means for controlling the plurality of production machines based upon the planned production in the master schedule file;

an electronically stored parts manual, containing a hierarchical listing of parts in the plurality of production machines in the plurality of production complexes;

maintenance schedule management means, for identifying parts in the hierarchical listing to be maintained during a predetermined time period based upon the planned production in the master schedule file, and for scheduling maintenance activities for the identified parts to reduce disruption of production;

engineering change control management means, for integrating engineering change control activities into the scheduled maintenance activities;

parts manual management means, for updating the hierarchical listing in response to maintenance activities and engineering change control activities; and,

spares inventory management means, for generating requirements to order replacement parts for the identified parts to be available for use in the scheduled maintenance activities.

103. The computer integrated manufacturing and maintenance system of claim 98 wherein said hierarchical listing of parts in said electronically stored parts manual comprises a plurality

of parts levels from a lowest level to a highest level, and wherein each part in the lowest level is identified as being one of a consumable part which is consumed by the production process, a replaceable part which has an extended life but is subject to wear or failure, a generic part which is a common part used in large numbers on many of the production machines, and a non-stocked part which does not normally require replacement.

105. The computer integrated manufacturing and maintenance system of claim 104 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

110. The computer integrated manufacturing and maintenance system of claim 98 further comprising:

an electronically stored spares inventory file for identifying generic parts used in said plurality of production machines and replaceable parts used in said plurality of production machines; and

said spares inventory management means further comprising means for generating requirements to order a generic part when an inventory quantity falls below a predetermined quantity and for identifying requirements to order a replacement part to be available for use in the scheduled maintenance activities.

123. The computer integrated maintenance system of claim 122 wherein said electronically stored parts manual further includes a replacement part number for selected one of the parts.

144. The computer integrated maintenance method of claim 143 wherein said generating step further comprises the step of generating an electronically stored parts manual including a replacement part number for selected ones of the parts.

153. A compute integrated maintenance system for a complex including a plurality of machines used to perform a primary function and which also require maintenance; said computer integrated maintenance system comprising;

an electronically stored parts manual, containing a hierarchical listing of parts in the plurality of machines in the complex;

maintenance operations computer controlling means, communicatively connected to the electronically stored parts manual, said maintenance operations computer controlling means comprising:

maintenance schedule management means, for identifying parts in the hierarchical listing to be maintained during a predetermined time period based upon a planned use schedule for the machines, and for scheduling maintenance activities for the identified parts to reduce loss of use of the complex;

engineering change control management means, for integrating engineering change control activities into the scheduled maintenance activities;

parts manual management means, for updating the hierarchical listing in response to maintenance activities and engineering change control activities; and,

spares inventory management means, for generating requirements to order replacement parts for the identified parts to be available for use in the scheduled maintenance activities.

158. The computer integrated maintenance system of claim 153 wherein said hierarchical listing of parts in said electronically stored parts manual comprises a plurality of parts levels from a lowest level to a highest level, and wherein each part in the lowest level is identified as being one of a consumable part which is consumed by the machine, a replaceable part which has an extended life but is subject to wear or failure, a generic part which is a common part used in large numbers on many of the machines, and a non-stocked part which does not normally require replacement.

160. The computer integrated maintenance system of claim 159 wherein said electronically stored

parts manual further includes a replacement part number for selected ones of the parts.

165. The computer integrated maintenance system of claim 153 further comprising:

an electronically stored spares inventory file for identifying generic parts used in said plurality of machines and replaceable parts used in said plurality of machines; and

said spares inventory management means further comprising means for generating requirements to order a generic part when an inventory quantity falls below a predetermined quantity and for identifying requirements to order a replacement part to be available for use in the scheduled maintenance activities.

Previous Doc Next Doc Go to Doc#

L6: Entry 6 of 6 File: USPT Jun 1, 1993

DOCUMENT-IDENTIFIER: US 5216612 A
TITLE: Intelligent computer integrated maintenance system and method

Brief Summary Text (7):
The art has heretofore suggested adding a maintenance module to a computer integrated manufacturing system in order to integrate maintenance of the production machines into the computer integrated manufacturing system. For example, the Haynes et al. '772 patent noted above discloses a glassware production control system which also provides maintenance information. The Ohno et al. '634 patent noted above also describes a production process control computer which includes a materials and maintenance control subsystem. The materials and maintenance control subsystem controls the timing of parts replacement. The timing of parts replacement is calculated in advance from the cumulative total of the predicted life of consumable parts and operation time and displayed or printed so as to enable order placement for parts. The maintenance system includes a parts list file containing a list of all consumable parts in the system. The parts list file is updated by collecting information on the operation of the machine so that residual service lives of consumable parts may be calculated. When parts replacement is needed, the quantity of parts used for replacement is deducted from the stock volume in the parts inventory file. When the stock volume of parts in the parts inventory file becomes smaller than at the time of parts ordering, an order form slip is printed. In other words, a "point of ordering" system is provided. A running total of elapsed time is computed and compared with the durable life of parts so that the time and date of actual replacement can be calculated and a schedule of maintenance may thereby be derived.

Brief Summary Text (22):
As described above, the intelligent computer integrated maintenance system of the present invention also includes a parts manual management subsystem which controls a parts manual file. The parts manual file contains a complete bill of materials for each production machine. The electronically stored parts manual file does not merely include consumables or maintenance parts. Rather, it includes all parts in the machine in a hierarchial listing, commonly using 5-6 levels of parts, so that a complete subsystem description of the machine is available. Preferably, an electronically stored image of each level is also stored with the listing of parts so that maintenance parts can be identified and repairs are simplified. According to the invention, all parts in the hierarchical listing are categorized as either "consumable", "replaceable", "generic" or "non-stocked". Consumable parts are those for which spare parts planning is based on the number of hours used. For replaceable parts, the mean-time to failure rate versus the actual run time determines the maintenance schedule. For generic parts such as screws, bulk inventory is maintained and a point of ordering system is used. Finally non-stocked parts, which are typically not maintenance parts, are typically not stocked and are not ordered until actually needed.

Brief Summary Text (24):
The spare parts inventory management subsystem of the intelligent computer integrated maintenance system allows ordering of spare parts based on predicted maintenance, rather than on the prescribed inventory levels. Spare parts budgeting is also accommodated. According to the invention, generic parts are ordered using a conventional order point system when the inventory quantities fall below a predetermined order point. For replaceable parts, however, the parts requirements are calculated based on time phased manufacturing requirements and mean-times to failure. The automated parts manual file is used to extend the production plan to parts replacement. A requirement is generated to replace a part in the week that it will exceed its mean-time to failure, and order forms for the parts are generated, or the parts may be ordered electronically.

Detailed Description Text (11):
Parts manual management subsystem 5 is designed to operate with an electronically stored parts manual file 7 which contains a hierarchical listing of all parts in the production machines in the complexes. The parts listing does not merely include maintenance or consumable parts; it includes a complete bill of materials for each production machine. Preferably, accompanying each bill of materials is an image of the associated bill of materials. For a typical machine 5-6 levels of materials are provided with the highest level being the part number for the entire machine, and the lowest level being the lowest replaceable part level for the machine.

Detailed Description Text (23):
A work plan stating the steps to be performed for each planned maintenance operation is created by the maintenance schedule management subsystem. Time-phased events are extended by the work plan to calculate the man hours, by labor grade and machine hour down time required to perform each task. The time-phase man hours are then compared to the man hours available for each week. Man hours available can be defined as the total maintenance hours (maintenance staff multiplied by the hours of the week) minus the time reserved for unplanned or emergency maintenance. For example, if ten employees perform full time maintenance activities and there are 40 hours in a week, then there are 400 total maintenance hours available per week. If a 40% contingency is reserved for unplanned maintenance, then 160 of the 400 hours represent unplanned hours and 240 hours may be dedicated for planned events.

Detailed Description Text (25):
FIG. 2 illustrates the results of planning and scheduling of maintenance operations by the maintenance schedule management subsystem 3. As shown in FIG. 2, the time dependent maintenance requirements are calculated in terms of both man hours and machine hours on a per week basis. The usage dependent man hours and machine hours are also calculated based on the master production schedule file 13. Maintenance Improvement Committee directive changes are also calculated in terms of man hours and machine hours. Then, the total capacity required in terms of man hours and machine hours is calculated for each week. The total capacity required is then compared to the hours available. It will be understood that the total hours include a 40% reserve for unplanned maintenance. Subtracting the hours reserved for unplanned maintenance yields the remaining hours which can be scheduled. As shown in FIG. 2, it is assumed that 10 man hours and 10 machine hours are available for planned maintenance. It will be seen that week one includes a one man hour capacity shortage, week four produces a seven man hour and two machine hour shortage, and week twenty-six produces a ten man hour and seven machine hour shortage.

Detailed Description Text (30):
Referring to FIG. 3 it will be noted that all parts that comprise a piece of equipment are maintained in the parts manual file, not merely those parts which are consumables or maintenance parts. Accordingly, the parts manual file contains a hierarchical listing of all parts in each machine in the plurality of production complexes. As will be described below, each level of parts in the parts manual file is preferably accompanied by a graphic image illustration of the interrelation of those parts.

Detailed Description Text (31):
All of the parts that comprise a piece of equipment, and which are included in the parts manual file, may be divided into four categories: consumable, replaceable, generic, and non-stocked. Consumable parts are those which are consumed by the production process but not maintained on a list of materials required to produce a product. Some examples include printing dies, tape belts and cutting blades. Because parts of this type must be replaced when they wear out or are used up, they are listed as component items in the parts manual file. According to the invention, spare parts planning for consumable parts is based on future run hours as determined by the maintenance schedule management subsystem 3. For example, tape belts are replaced at the beginning of each production shift. Therefore, each scheduled complex must have a set of tape belts for each production shift scheduled. The total number of tape belts required to support the planned schedule provides the number of belts required each day, week or month.

Detailed Description Text (32):
Replaceable parts are those which have an extended life but are subject to wear or failure. Examples include fans, motors, shafts and drives. These items have a mean-time failure rate which is initially provided by the machine vendor, who is normally the supplier of replacement parts. According to the invention, actual run hours and future run hours for these parts are

determined from the master production schedule file and compared to the mean-time failure rate to determine projected parts replacement. When these parts are replaced, the actual run hours are set to zero and the accumulation cycle begins again. The replaceable part information (including for example, complex equipment number, maintenance request number, accumulated hours and other pertinent data) is saved in a parts history file described below. Statistical analysis is applied to review the mean-time failure rate for the part in this complex. If a vendor supplied mean-time failure rate is available, it is reviewed and modified when necessary. When no vendor supplied rate is available, a historical mean-time failure rate will be calculated based on parts history information. The parts manual file also provides information on replacement parts which are still under warranty by the vendor. The vendor's warranty date and/or warranty hours are maintained for the warranty comparison.

Detailed Description Text (37):
It will be understood by those having skill in the art that under certain circumstances it may be necessary to procure replacement parts prior to the modification of the parts manual file. For example, in an efficiency upgrade program, replacement parts may be identified for the improvement before the sequence in which complexes are to be modified has been determined. Another example is when an improvement kit has been obtained but the engineering drawing is not yet available. In both cases "Planning Bills of Material" provide a method of identifying the replacement parts and timing associated with an improvement program. The engineering department can create a planning bill for engineering changes without modifying the parts manual file.

Detailed Description Text (45):
The Spares Inventory Management Subsystem 6 controls the ordering of spare parts. According to the invention, generic items such as nuts, bolts and washers, are reordered using a typical "order point" technique. In other words, when the quantity on hand falls below a predetermined order point, a replacement order is generated for a standard order quantity.

Detailed Description Text (46):
Replaceable parts are managed using time-phased requirement techniques. The planning cycle consists of three steps. First, the time-phase parts requirements are calculated. These requirements come from three sources: parts required to support time-phased maintenance requests, parts defined on planning bills and anticipated parts replacement due to parts exceeding the mean-time failure rate. Anticipated parts replacement takes the current production plan for each complex and extends the plan through the hierarchical description in the automated parts manual. The planned run hours for each week are added to the actual run hours. A requirement is then created to replace the part during the week in which it will exceed the mean-time failure rate and the accumulated run hours are set to zero for that week. This yields the anticipated replacement requirements of all complexes which is summed to derive the total time-phased replacement requirements for the part. The time-phased requirements consumes the on-hand inventory until it is depleted. Spare parts used to support unplanned maintenance are removed from the on-hand inventory when the spare parts are issued. Replacement of these spare parts may cause the system to order them sooner than originally planned.

Detailed Description Text (47):
Finally, a replacement order is created for each week in which requirements exceed the on-hand balance, or safety stock, if one is maintained. The replacement order may be released to the supplier a predetermined number of days prior to when the part is required, based upon the lead-time that the vendor requires to ship the part. All spare parts required to support the maintenance requests, planning bills and replacement parts are combined to determine the total amount to be ordered for each spare part. The system may also generate paper order forms for the parts, or may electronically order the parts.

Detailed Description Text (57):
If an increase in machine utilization cannot resolve capacity requirements (Block 35) the third course is to compare the required capacity to the excess capacity of other complexes, at Block 37. The long term trend of the other complexes is analyzed and Complexes which can be modified to produce the required products are selected at Block 38. Then, at Block 39 maintenance requests are created to perform the modifications if they occur in the first year of the planning horizon.

Detailed Description Text (76):
This yields the labor hours required to perform all of the maintenance requests (Block 63). The

weekly labor hours available (total labor hours minus percent reserved for unplanned maintenance) is obtained at Block 64 and is compared to the weekly labor hours required. The production schedule is also obtained at Block 65. Finite scheduling techniques, involving automatic priority revision in order to level maintenance operations to the time available, are used to resolve all overloaded weeks and reschedule maintenance at Block 66. Each maintenance request is examined for criticality. The less critical maintenance requests are rescheduled to fill weeks where excess labor hours exists. This rescheduling is filtered by the production schedule obtained at Block 65 to ensure that the impact to the inventory policy is minimized. The result is a new maintenance schedule (Block 67) and a new production schedule (Block 68) An integrated weekly plan is now available.

Detailed Description Text (91):
The operator may then select the next piece of equipment to look at. As shown in FIG. 10A, the packer was selected and display of FIG. 10B is displayed. The packer has eight sections. An image of each is displayed on the left side of the display of FIG. 10B. The upper right corner includes a list of the parts. The lower right corner contains the above described "help", "exit", and "explode bill" option described above. Options also allow detail information (such as company part number, type of part or replacement history) to be displayed, allows return to a higher level in the hierarchy, allows an image to be printed, or a new assembly to be specified.

Detailed Description Text (92):
When the maintenance operator selects option 1 - FRAME SECTION 1" the computer reveals the next level of the machinery shown in FIG. 10C. When the maintenance operator selects option 1-part 0051, the last assembly of this sector appears on the computer along with the parts list (FIG. 10D). This is the lowest level in the hierarchial listing of parts. The maintenance operator may select the parts which are required by placing a `P` beside the parts displayed. The parts will be automatically ordered, assigned an emergency maintenance request number, unless this is a planned modification, and the Parts Manual File will be updated to reflect the replacement parts. The Parts Manual Management Subsystem cooperates with the Spares Inventory Management System, as described below, to review part availability and to automatically issue the requested parts. The Parts Manual Management Subsystem also cooperates with the Maintenance Schedule Management System described above. All planned and unplanned maintenance requests are implemented through the Parts Manual Management Subsystem.

Detailed Description Text (97):
All modifications to the Parts Manual File are controlled by the Engineering Change Control Management Subsystem 4 (FIG. 1). Referring to FIG. 11, the detailed operation of the Engineering Change Control Management Subsystem will now be described. An Engineering Change Number (ECN) is assigned for every modification to the Parts Manual File. The criteria to implement the modification, such as a date, is also assigned to the Engineering Change Number (ECN). All permanent modifications to the Parts Manual File are coordinated by a central Engineering Change Control (ECC) function. Each plant can establish temporary changes for plant trial modifications. These changes are in effect for a short duration and will be automatically removed, for example after 10 working days. Plant trial modifications must be submitted through the central ECC function when the modifications are to become permanent.

Detailed Description Text (101):
A new part added to the Parts Manual File is classified as "inactive" and will not appear on the Parts Manual File until an engineering change number is assigned. A part to be removed will be flagged as such when the engineering change number is assigned. A replacement part is a two step operation: (1) remove the current part to be replaced; (2) add the replacement part.

Detailed Description Text (103):
FIG. 12 shows two examples of Engineering Change Control (FIG. 11, Block 106) and updating the Parts Manual (FIG. 11, Block 108). The first example in FIG. 12 is for drawing number 0051.01. Engineering Change Number 1010 indicates that this drawing is to be deleted (1010D) and replaced by 0051.01.01 (1010A) on 2/10/XX. Drawing number 0051.01 will be used prior to 2/10/XX. Drawing 0051.01.01 will be used beginning 2/10/XX. The second example in FIG. 12 is for a part replacement. The distributor 4030 will be replaced by 4030.01 on 2/5/XX, controlled by Engineering Change Number 1011. Distributor 4030 is to be used before 2/5/XX (1011D). Distributor 4030.01 will be used beginning 2/5/XX (1011A). FIG. 13 shows the parts lists in effect on 2/5/XX.- FIG. 14 shows the same parts lists in effect on 2/10/XX. The parts list in

FIGS. 12, 13 and 14 represent three different parts lists over a period of time based on the criteria of each engineering change number.

Detailed Description Text (108):
(3) The completion of a maintenance request (Blocks 113 and 117) will close an engineering change number. This can occur when maintenance issues a MR to implement a MIC directive (Block 113) or when emergency maintenance is performed (Block 117). Engineering services will be notified when a part was replaced which was not listed in the Parts Manual File.

Detailed Description Text (125):
Next, referring to FIG. 24, the engineering change control entries are created. ECN 123--Group PM schedule--is date controlled (Block 175) to go into effect on 2/15/xx. ECN 456 is coded as a vendor part replacement to be implemented when Part-F is depleted (Block 173). This requires that Part-F be in the part master file (Block 176) and that the inventory quantity on-hand be greater than 0 (Block 177), plus any reserved stock if desired. ECN 789 is to implement a MIC improvement (Block 172) modification and will be effective when MR123 is completed. ECN 886 is another part use-up (Block 173). This one replaces one XYZ part with another XYZ part. This is the only ECN implemented through the part master.

Detailed Description Text (136):
Referring to FIG. 27, each part issued to a MR (Block 221) is checked to determine if that part is under ECN control (Block 222). The request is suspended (Block 224) and engineering services is notified for corrective action (Block 225) when a part is not under ECN control.

Detailed Description Text (138):
A part issued to a parts list item coded as delete (DEL) (Block 226) is suspended (Block 224) and engineering services is notified for corrective action (Block 225).

Detailed Description Text (141):
The request is suspended (Block 244) and engineering services notified (Block 246) for action when the MR is closed (Block 243) but the ECN is still open (Block 247).

Detailed Description Text (147):
Consumable parts not maintained on the production bill-of-material, such as adhesives, are listed as component items. Dies which print the product logo, inks and cutting blades are further examples of consumable parts not maintained on the production bill-of-materials. These items are replaced when they wear out or are used up. Spare parts for consumables are planned based on future run hours. For example, cutting blades are replaced at the beginning of each production shift. Accordingly, each scheduled complex must have a set of cutting blades for each production shift scheduled. Accumulating the cutting blades required to support the plant schedule yields the amount of cutting blades required each day, week or month.

Detailed Description Text (148):
Replaceable parts, such as fans, motors, shafts and drives, are those spare parts which have an extended life but which can break. These items have a mean-time failure rate which is initially rated by the vendor. The vendor normally supplies these parts. Posting the actual run hours to these parts and accumulating the future run hours provides the ability to compare the run hours to the mean-time failure rate and time-phase projected parts replacement.

Detailed Description Text (149):
In general, Spares Inventory Management Subsystem 8 manages the purchasing of spare parts in the following way: Non-stocked parts are purchased upon request. Generic parts are reordered using typical "Order Point" techniques. In other words, when the quantity on-hand falls below the predetermined order point, a replacement order is placed for a predetermined order quantity. Consumable and replaceable parts are managed using a time-phased requirements technique. This time-phased technique will now be described.

Detailed Description Text (153):
Each spare part classified as "consumable" or "replaceable" has a mean-time failure rate. The mean-time failure rate is the number of run hours at which this part is likely to fail or need replacement. Each part accumulates their actual run hours--stored in the cumulative run hours field. The planned run hours for each week are also accumulated for these parts. The planned run hours are added to the actual run hours. The results are compared to the mean-time failure

rate. A requirement for the part is created each time the planned run hours exceeds the mean-time, failure rate.

Detailed Description Text (155):
Replacement parts which are still under warranty by the vendor are listed for warranty replacement. The vendor's warranty date and/or warranty hours are maintained for the warranty comparison.

Detailed Description Text (156):
(2) Spare Parts Identified in the Planning Bill: As already described, "Planning Bills" can be set up for regularly scheduled maintenance events such as preventative maintenance, machine configuration changes and consumable parts. This type of planning bill defines each spare part required to perform a maintenance event. This provides greater flexibility to engineering services. A parts list can be maintained for spare parts planning using the planning bill rather than coding the detail in the parts manual file.

Detailed Description Text (169):
(3) Each week that the projected cumulative run hours exceed the mean-time failure rate, a replacement part is required. The projected cumulative run hours is reset by subtracting the mean-time failure rate for the projected cumulative run hours.

Detailed Description Text (171):
Continuing with the example of FIG. 32, after each projected cumulative run hours is calculated, it is compared to the mean-time failure rate. A "requirement" is created each time that the mean-time failure rate is exceeded. This occurs twice in FIG. 32. Week 5 has a projected cumulative run hours of 1400. The mean-time failure rate is 1375. Since the projected cumulative run hours exceeds the mean-time failure rate by 25 hours (1400-1375) a requirement is created. The projected cumulative run hours is reduced by the mean-time failure rate and the calculations for projected cumulative run hours begins again. Week 6 has a projected cumulative run hours of 125 consisting of 25 projected cumulative run hours from week 5 (1400-1375) plus the 100 planned run hours for week 6. The second occurrence for creating a requirement is in week 21.

Detailed Description Text (189):
Referring again to FIG. 30, at Block 283, the part is checked for ECN use-up control. If the part is to be phased out (replaced) when it is used-up, the remaining requirements for this part must be posted to the substitute part (Block 284). FIG. 34 shows this example. Part 01B16 Part-F is under control of ECN 456--use-up to be replaced by 01B15 Part-E. The first time the projected on-hand goes negative (-3) for this part (Part-F) is week 5 (Block 285). The remaining requirements for week 5 (-3) and all future requirements for this part are posted to the replacement part (01B15 Part-E) at Block 286. The replacement part is at least one planning level lower than the current planning level. This insures that the remaining requirements for this part are included in the requirements for the replacement part. This technique is used for planning purposes only. The ECN will go into effect when the last part is actually issued from spares.

Detailed Description Text (190):
The last function performed in the spare part planning cycle is the Buyer Recommendation (Block 287). Although the system calculates when to place an order or to advise the rescheduling of an existing purchase order, the Buyer is responsible for the actual company commitment. The system will not automatically issue or reschedule a purchase order. However, it will be understood by those having skill in the art that the system may be configured to automatically issue or reschedule a purchase order.

CLAIMS:

13. The computer integrated maintenance system of claim 12 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

34. The computer integrated manufacturing and maintenance system of claim 33 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

55. The computer integrated maintenance method of claim 54 wherein said generating step further comprises the step of generating an electronically stored parts manual including a replacement part number for selected ones of the parts.

76. The computer integrated manufacturing and maintenance method of claim 75 wherein said generating step further comprises the step of electronically stored parts manual which includes a replacement part number for selected ones of the parts.

85. A computer integrated maintenance system for use with a computer integrated manufacturing system, the computer integrated manufacturing system including a computer controller for controlling a plurality of production complexes each of which includes a plurality of production machines, the manufacturing system computer controller including an electronically stored master schedule file having therein a schedule of actual production and planned production for the plurality of complexes, the manufacturing system computer controller controlling the plurality of production machines based upon the planned production in the master schedule file, said computer integrated maintenance system comprising:

an electronically stored parts manual, containing a hierarchical listing of parts in the plurality of production machines in the plurality of production complexes;

maintenance operations computer controlling means, adapted to be communicatively connected to the manufacturing system computer controller, and communicatively connected to the electronically stored parts manual, said maintenance operations computer controlling means comprising:

maintenance schedule management means, for identifying parts in the hierarchical listing to be maintained during a predetermined time period based upon the planned production in the master schedule file, and for scheduling maintenance activities for the identified parts to reduce disruption of production;

engineering change control management means, for integrating engineering change control activities into the scheduled maintenance activities;

parts manual management means, for updating the hierarchical listing in response to maintenance activities and engineering change control activities; and,

spares inventory management means, for generating requirements to order replacement parts for the identified parts to be available for use in the scheduled maintenance activities.

90. The computer integrated maintenance system of claim 85 wherein said hierarchical listing of parts in said electronically stored parts manual comprises a plurality of parts levels from a lowest level to a highest level, and wherein each part in the lowest level is identified as being one of a consumable part which is consumed by the production process, a replaceable part which has an extended life but is subject to wear or failure, a generic part which is a common part used in large numbers on many of the production machines, and a non-stocked part which does not normally require replacement.

92. The computer integrated maintenance system of claim 91 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

97. The computer integrated maintenance system of claim 85 further comprising:

an electronically stored spares inventory file for identifying generic parts used in said plurality of production machines and replaceable parts used in said plurality of production machines; and

said spares inventory management means further comprising means for generating requirements to order a generic part when an inventory quantity falls below a predetermined quantity and for identifying requirements to order a replacement part to be available for use in the scheduled maintenance activities.

98. A computer integrated manufacturing and maintenance system for controlling manufacturing and maintenance of a plurality of production complexes each of which includes a plurality of

production machines, said computer integrated manufacturing and maintenance system comprising:

an electronically stored master schedule file having therein a schedule of actual production and planned production for the plurality of complexes;

means for controlling the plurality of production machines based upon the planned production in the master schedule file;

an electronically stored parts manual, containing a hierarchical listing of parts in the plurality of production machines in the plurality of production complexes;

maintenance schedule management means, for identifying parts in the hierarchical listing to be maintained during a predetermined time period based upon the planned production in the master schedule file, and for scheduling maintenance activities for the identified parts to reduce disruption of production;

engineering change control management means, for integrating engineering change control activities into the scheduled maintenance activities;

parts manual management means, for updating the hierarchical listing in response to maintenance activities and engineering change control activities; and,

spares inventory management means, for generating requirements to order replacement parts for the identified parts to be available for use in the scheduled maintenance activities.

103. The computer integrated manufacturing and maintenance system of claim 98 wherein said hierarchical listing of parts in said electronically stored parts manual comprises a plurality of parts levels from a lowest level to a highest level, and wherein each part in the lowest level is identified as being one of a consumable part which is consumed by the production process, a replaceable part which has an extended life but is subject to wear or failure, a generic part which is a common part used in large numbers on many of the production machines, and a non-stocked part which does not normally require replacement.

105. The computer integrated manufacturing and maintenance system of claim 104 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

110. The computer integrated manufacturing and maintenance system of claim 98 further comprising:

an electronically stored spares inventory file for identifying generic parts used in said plurality of production machines and replaceable parts used in said plurality of production machines; and

said spares inventory management means further comprising means for generating requirements to order a generic part when an inventory quantity falls below a predetermined quantity and for identifying requirements to order a replacement part to be available for use in the scheduled maintenance activities.

123. The computer integrated maintenance system of claim 122 wherein said electronically stored parts manual further includes a replacement part number for selected one of the parts.

144. The computer integrated maintenance method of claim 143 wherein said generating step further comprises the step of generating an electronically stored parts manual including a replacement part number for selected ones of the parts.

153. A compute integrated maintenance system for a complex including a plurality of machines used to perform a primary function and which also require maintenance; said computer integrated maintenance system comprising;

an electronically stored parts manual, containing a hierarchical listing of parts in the plurality of machines in the complex;

maintenance operations computer controlling means, communicatively connected to the electronically stored parts manual, said maintenance operations computer controlling means comprising:

maintenance schedule management means, for identifying parts in the hierarchical listing to be maintained during a predetermined time period based upon a planned use schedule for the machines, and for scheduling maintenance activities for the identified parts to reduce loss of use of the complex;

engineering change control management means, for integrating engineering change control activities into the scheduled maintenance activities;

parts manual management means, for updating the hierarchical listing in response to maintenance activities and engineering change control activities; and,

spares inventory management means, for generating requirements to order replacement parts for the identified parts to be available for use in the scheduled maintenance activities.

158. The computer integrated maintenance system of claim 153 wherein said hierarchical listing of parts in said electronically stored parts manual comprises a plurality of parts levels from a lowest level to a highest level, and wherein each part in the lowest level is identified as being one of a consumable part which is consumed by the machine, a replaceable part which has an extended life but is subject to wear or failure, a generic part which is a common part used in large numbers on many of the machines, and a non-stocked part which does not normally require replacement.

160. The computer integrated maintenance system of claim 159 wherein said electronically stored parts manual further includes a replacement part number for selected ones of the parts.

165. The computer integrated maintenance system of claim 153 further comprising:

an electronically stored spares inventory file for identifying generic parts used in said plurality of machines and replaceable parts used in said plurality of machines; and

said spares inventory management means further comprising means for generating requirements to order a generic part when an inventory quantity falls below a predetermined quantity and for identifying requirements to order a replacement part to be available for use in the scheduled maintenance activities.

Previous Doc Next Doc Go to Doc#

L6: Entry 5 of 6 File: PGPB Jun 20, 2002

DOCUMENT-IDENTIFIER: US 20020077979 A1
TITLE: Service management method, product-in-circulation to which the same is applied, service management device, service management network system, service management program, and computer-readable program product with the program stored thereon

Summary of Invention Paragraph:
[0015] Using an image forming apparatus with the function to predict the remaining product life by electronic means may be somewhat helpful to establish a fairly reliable, automatic day-to-day control system that even works with a stock of a least number of spare consumable products possible.

Summary of Invention Paragraph:
[0018] Japanese Laid-Open Patent Application No. 11-126008/1999 mentioned above is directed to the recording of use history of individual components of a toner cartridge and the determining as to whether the components are recyclable based on the history. The technique is aimed at reducing manufacturing cost of toner cartridges and making efficient use of energy and natural resources; however it does not give any solution at all to the undesirable expenses the user is forced to spend on spare consumable parts.

Summary of Invention Paragraph:
[0024] Methods have been conventionally proposed to identify genuine replacement parts to determine if those installed in an image forming apparatus are original. Japanese Laid-Open Patent Application No. 59-145179/1984 (Tokukaisho 59-145179, published on Aug. 20, 1984) discloses such a method to identify an original replacement part whereby a photoelectric or magnetic sensor detects a specified mark borne by the original replacement part. Japanese Laid-Open Patent Application No. 2-73264/1990 (Tokukaihei 2-73264, published on Mar. 13, 1990) discloses another whereby original replacement parts are equipped with a pressure-sensitive conductor of a complex shape to be distinguished from non-original replacement parts. Japanese Laid-Open Patent Application No. 9-185311/1997 (Tokukaihei 9-185311, published on Jul. 15, 1997) discloses still another whereby original replacement parts are equipped with a pattern of small lumps and dents which is detected by a mechanical switch with a normally open contact to be distinguished from non-original replacement parts.

Summary of Invention Paragraph:
[0025] There are advanced methods whereby not only the replacement part is checked for its genuine origin, but the image forming apparatus is controlled to operate normally only when the replacement part is identified as original. Japanese Laid-Open Patent Application No. 5-224479/1993 (Tokukaihei 5-224479, published on Sep. 3, 1993) discloses such a method to recognize an original replacement part being installed in the image forming apparatus, whereby the replacement part has an attached code label carrying a specified set of data, and the image forming apparatus is permitted to operate normally only upon the reading of the set of data.

Summary of Invention Paragraph:
[0026] A disadvantage of these methods is that they can be circumvented easily by third parties producing counterfeit goods and fall far short of eradicating fake parts from the market. Disposable replacement parts are particularly difficult to eradicate from the market, because third parties have to only collect them and replace nothing but toner for example, before introducing them into the market as new products. Another problem is that conditions in using counterfeit parts are difficult to recognize, making it difficult to perform maintenance. Besides, recycled replacement parts may be introduced into the market repeatedly even after they have worn out, because keeping track of the number of times recycled is impossible.

Summary of Invention Paragraph:

[0027] These problems are addressed in Japanese Laid-Open Patent Application No. 10-69139/1998 (Tokukaihei 10-69139; published on Mar. 10, 1998). The patent application discloses a method whereby the copying machine operates normally if an ink bottle (replacement part) is genuine and stops operating normally or records the use conditions of the counterfeit in the memory if not. This is achieved by the original ink bottles being equipped with a data carrier composed of a nonvolatile memory to record data specified depending on the model of the copying machine and the control section being provided in the copying machine to determine if the data recorded in the data carrier has normal values.

Summary of Invention Paragraph:
[0029] The manufacturer and distribution manager of ink bottles cannot know that the users of the copying machines have bought imitations before a service person visits the users to pick up ink bottles or the manufacturer is notified so by the users. The manufacturer or distribution manager may notice the circulation of imitations only after a time lag.

Summary of Invention Paragraph:
[0030] Japanese Laid-Open Patent Application No. 10-69139/1998 above further discloses a method to prevent third parties from collecting used ink bottles and other replacement parts only for the data carriers and attaching those data carriers to non-genuine parts for new use. This is achieved by destructing the data carriers when the replacement parts are detached from the machines to replace them. However, something must be done to avoid destruction of the data carrier when the replacement part is detached only for maintenance. Someone must therefore select destruction or non-destruction of the data carrier, depending on whether the replacement part is detached for maintenance or replacement. This is both bothersome to that person and may cause the person to make an error that leads to unintended destruction of the data carrier.

Summary of Invention Paragraph:
[0031] The foregoing methods are aimed at achieving a common goal of eradicating non-original parts, by notifying the user that a non-original part is installed in the image forming apparatus, disabling non-original parts, etc. However, none of them is capable of producing a satisfiable result in the attempt to squeeze non-original parts out of the market.

Summary of Invention Paragraph:
[0034] Imitations come in some forms. Some are disposable replacement parts and collected by third parties after they are discarded. These are refilled with new toner or another kind of recording material and reintroduced into the market, disguising as new products. Some are recycled without controlling quality, such as the number of times recycled.

Summary of Invention Paragraph:
[0053] i) detecting unique data specifying a replacement part installed in an apparatus via a network; and

Summary of Invention Paragraph:
[0054] ii) determining if the replacement part installed in the apparatus is an original product registered in memory means which stores therein unique data on a registered original product by collating the unique data detected in the step i) with unique data read out from the memory means by making an access to the memory means.

Summary of Invention Paragraph:
[0055] According to the arrangement, unique data can be used to identify replacement parts. Further, the unique data registered in the memory means can be compared with the unique data detected of the replacement parts installed in the apparatus, so as to quickly determine whether the replacement parts are original products whose unique data is registered or non-original products whose unique data is not registered.

Summary of Invention Paragraph:
[0056] Further, the unique data of the replacement part is both registered and detected over a network; the service provider for replacement parts can control distribution of replacement parts in a centralized manner and readily know how non-original products are distributed. Measures can be quickly taken to eradicate non-original products from the market. This quick response restrains occurrence of non-original products as much as possible and spread of occurrence in smallest possible confines.